on the involved upper extremity, led to an exacerbation of symptoms. Additionally, the patient displayed posterior glenohumeral capsular tightness, which led to decreased joint motion and improper joint arthrokinematics. The prognosis for a full recovery for this patient was excellent, given her health and activity level, and recovery was expected to be seen after approximately 8-12 weeksof conservative physical therapy intervention, via the literature [1].

Intervention

The patient was seen twice a week for a six-week duration for a total of twelve sessions with goals of increasing ROM, improving arthrokinematics of the glenohumeral joint, the rotational and translational osteokinematics of the scapulothoracic interface, decreasing capsular tightness, and progressing to full and pain free shoulder ROM. Interventions focused primarily on manual therapy and therapeutic exercise to obtain these goals. **Table 7** depicts the precise daily intervention progression through the entire episode of carefor the patient.

In the literature, Dressendorfer and Brence note that muscle force couple imbalance is the primary impairment which leads to altered arthrokinematics and eventually SIS symptomology [2,4]. This was exactly the case in this patient. By addressing these muscular imbalances, proper scapular

Table 7. Interventions provided for each treatment sessions.

Treatment Session	Intervention	Parameters	Rationale
1	• Initial evaluation	• 1 hour	• Development of POC
2	• Soft tissue work* • Robbery rows • Prone scapular depressions	• 30 mins • 3 sets,10 reps, red resistance tubing • 3 sets,10 reps	• Assist with resolution of trigger points • Increase strength of scapular stabilizers to facilitate proper scapulohumeral rhythm
3	• Sustained left shoulder stretching • Joint mobilizations • Robbery rows • Prone scapular depressions • Sitting scapular depressions	• 15 mins • 10 mins • 3 sets, 10 reps, red resistance tubing • 3 sets, 10 reps • 3 sets, 10 reps, green resistance tubing	• Increase end joint ROM by stretching posterior capsule • Facilitate proper movement of humeral head within the glenohumeral joint • Increase strength of scapular stabilizers to facilitate proper scapulohumeral rhythm
4	• Manual soft tissue work to the upper trap and infraspinatus • Robbery rows • Prone scapular depressions • Sitting scapular depressions • Sidelying horizontal tabletop slides	• 25 mins • 3 sets, 10 reps, red resistance tubing • 3 sets, 10 reps • 3 sets, 10 reps, green resistance tubing • 3 sets, 10 reps, 2-pound dumbbell	• Assist with resolution of trigger points • Increase strength of scapular stabilizers to facilitate proper scapulohumeral rhythm
5	• Sustained left shoulder stretching • Joint mobilizations • Robbery Rows • Prone scapular depressions • Sitting scapular depressions • Sidelying horizontal tabletop slides • ER with resistance band at 90^0	• 15 mins • 10 mins • 3 sets, 10 reps, red resistance tubing • 3 sets, 10 reps • 3 sets, 10 reps, red resistance band • 3 sets, 10 reps, 2-pound dumbbell • 3 sets, 10 reps, red resistance tubing	• Increase ROM and decrease capsular tightness • Increase strength of scapular stabilizers • Increase strength of rotator cuff muscles to facilitate stabilization of humeral head within the joint
6	• Manual soft tissue work to supraspinatus and infraspinatus • Right sidelying ER with towel • Prone scapular depressions • Tabletops	• 25 mins • 3 sets, 10 reps, 2-pound dumbbell • 3 sets, 10 reps • 3 sets, 10 reps, 2-pound dumbbell	• Assist with resolution of trigger points • Increase strength of rotator cuff musculature to facilitate increased stabilization of the humeral head within the shoulder capsule • Increase strength of scapular stabilizers
7	• Manual soft tissue work to supraspinatus and rhomboids • Arm rest depressions • Robbery rows • Body blade • Right sidelying ER with towel • Tabletops • Prone 90-90 rows	• 20 mins • 3 sets, 12 reps, bodyweight • 3 sets, 12 reps, green resistance band • 3 sets, 30 seconds per set, sagittal and transverse plane • 3 sets, 12 reps, 2-pound dumbbell • 3 sets, 12 reps, 2-pound dumbbell • 3 sets, 12 reps, 4-pound dumbbell	• Assist with resolution of trigger points • Increase strength of rotator cuff musculature to facilitate increased stabilization of the humeral head within the shoulder capsule • Increase strength of scapular stabilizers

Continuation of Table 7.

8	• Manual soft tissue work to supraspinatus, rhomboids, infraspinatus • Robbery rows • Rhythmic stabilizations at GH joint • Resisted IR with towel under elbow • 4 way shoulder • R sidelying ER with towel	• 20 mins • 3 sets, 12 reps, green resistance band • 3 sets, 30 seconds, PT providing perturbations • 3 sets, 12 reps, red resistance band • 3 sets, 12 reps, green resistance band • 3 sets, 12 reps, 2-pound dumbbell	• Assist with resolution of trigger points • Increase strength of rotator cuff musculature to facilitate increased stabilization of the humeral head within the shoulder capsule • Increase strength of scapular stabilizers
9	• Manual soft tissue work to supraspinatus and infraspinatus • Humeral head joint mobilizations • Right sidelying ER with towel • Tabletops • Robbery rows • 4 way shoulder • Prone 90-90 rows • Prone 90-90 ball flips	• 10 mins • 10 mins, inferior and posterior grade III mobilizations • 3 sets, 12 reps, 2-pound dumbbell • 3 sets, 12 reps, 2-pound dumbbell • 3 sets, 12 reps, green resistance band • 2 sets, 12 reps, green resistance band • 3 sets, 12 reps, 4-pound dumbbell • 3 sets, 30 reps, 1.1-pound medicine ball	• Assist with resolution of trigger points • Facilitate increased motion through decreased capsular tightness and proper movement of the humeral head within the joint • Increase strength of rotator cuff musculature to facilitate increased stabilization of the humeral head within the shoulder capsule • Increase strength of scapular stabilizers
10	• Manual soft tissue work • Humeral head joint mobilizations • Robbery Rows • Table tops • R sidelying ER with towel • Prone 90-90 Rows • Resisted IR with towel • Prone 90-90 ball flips	• 15 mins • 10 mins • 3 sets, 12 reps, green resistance band • 3 sets, 12 reps, 2-pound dumbbell • 3 sets, 12 reps, 2-pound dumbbell • 3 sets, 12 reps, 4-pound dumbbell • 3 sets, 12 reps, red resistance band • 3 sets, 30 reps, 1.1-pound medicine ball	• Assist with resolution of trigger points • Facilitate increased motion through decreased capsular tightness and proper movement of the humeral head within the joint • Increase strength of rotator cuff musculature to facilitate increased stabilization of the humeral head within the shoulder capsule • Increase strength of scapular stabilizers
11	• Manual soft tissue work • Robbery rows • Standing 90-90 ball flips • Standing 90-90 ER static hold with perturbations from PT • Wallslides on forearms • Wall ball • Prone rows on Swiss ball	• 10 mins • 3 sets, 12 reps, green resistance band • 3 sets, 30 reps, 2.2-pound ball • 3 sets, 30 seconds, red resistance band • 3 sets, 12 reps, red resistance band • 1 set, 1 minute, in 4 different positions, clockwise and counter clockwise • 3 sets, 12 reps, 5-pound dumbbell	• Assist with resolution of trigger points • Increase strength of rotator cuff musculature to facilitate increased stabilization of the humeral head within the shoulder capsule • Increase strength of scapular stabilizers
12	• Shoulder assessment and re-testing		
HEP	• Bilateral passive shoulder flexion stretch • Rows • Push-up Plus • Shrugs • Doorway Pec stretch • Upper trap stretch • Sleeper stretch • Doorway ER stretch • Scapular depressions (seated and prone) • 4 way shoulder	• Pt was provided with resistance bands allowing her to complete HEP	

* Trigger points were treated via manual techniques including ischemic digital compression, massage, and/or soft tissue strumming techniques.

upward rotation (opposed to superior translation) and humeral head stabilization, without superior and anterior translation during movement, would theoretically be corrected [2,4]. To address these issues, the patient was instructed to begin with scapular stabilization exercises while allowing the irritation within the subacromial space to subside [8]. Through increasing

scapular stabilization, muscle force couple imbalances would be addressed, leading to more normalized glenohumeral arthrokinematics. Considering the results of the manual muscle testing, middle and lower trapezius, rhomboideus, and serratus anterior muscle strengthening was prioritized over strengthening of the upper trapezius. A study by Cools et al. found that patients with SIS often displayed hyperactive upper trapezius musculature with associated hypoactive lower trapezius muscle function during shoulder abduction [9]. Furthermore, with external rotation of the glenohumeral joint, Cools et al. found decreased activity of the middle trapezius with increased activity of the upper trapezius, also leading to muscle force couple imbalance [9]. With these force couple imbalances and the upper trapezius reacting faster than the lower trapezius, altered arthrokinematics with superior translation of the scapula opposed to upward rotation is common [10].

Once the exacerbation of pain within the subacromial space was mitigated with positioning and scapular stabilization, the interventions progressed to strengthening and improving the endurance of the rotator cuff musculature [4]. The rotator cuff is responsible for maintaining a stabilizing force to the humeral head in the glenoid fossa during flexion and abduction movements of the shoulder [2]. With weakness of the rotator cuff musculature, the stabilizing force is diminished and may lead to symptoms of impingement secondary to increased humeral head translation [2]. As stated by Ellenbecker and Cools, the primary goal with interventions are to achieve high levels of activation while decreasing the amount of subacromial contact [4]. Repetitions for the exercises aimed to achieve muscle fatigue to promote endurance gains [4].

The goal of therapeutic exercise was to improve strength deficits found during manual muscle testing, restore proper arthrokinematics, and increase the scapular stability as noted with bilateral scapular dyskinesia via observation.

The three primary manual therapy techniques used with this patient were manual stretching, joint mobilizations, and soft tissue mobilization. In manual stretching, the patient's involved shoulder was moved to end range and held for 30 seconds with inferior and posterior joint oscillations performed between each stretch(See **Table 7**). The reasoning behind using manual stretching was primarily to increase the patient's pain free ROM. However, in a study done by Bang and Deyle, they found patients receiving manual therapy, in addition to a supervised exercise program, experienced overall increased functional activity when compared to the control group who performed only a supervised exercise program [11]. Additionally, the experimental group also had a statistically significant strength gain and decrease in pain [11]. The strength gains demonstrated in this study were primarily seen with shoulder abductors, external and internal rotators [11].

Joint mobilizations were utilized to address hypomobility of the glenohumeral joint capsule noted in the posterior and inferior directions of the involved shoulder. Grades II and III oscillations were performed for pain relief and to repetitively load the restricted aspects of the joint capsule. The primary purpose of utilizing joint oscillations was to decrease the capsular restriction, thus leading to increased joint ROM and proper arthrokinematics [11,12]. In addition to the study by Bang and Deyle, Kachingwe et al., found that in two experimental groups receiving manual therapy (joint mobilizations and joint mobilizations along with mobilizations with movement), a higher percent change in pain and function (although not statistically significant) in the manual therapy groups from baseline to discharge when compared to a control group completing only a supervised exercise program [12]. This improvement in pain was likely due to movement within the joint that activated mechanoreceptors, leading to an analgesic response prior to completing their supervised exercise program [12]. The improvement in joint arthrokinematics likely resulted from capsular stretching during the manual techniques [12].

After reviewing the findings from available current literature, each treatment session with the patient began with manual therapy. The manual therapy and soft tissue techniques included joint mobilizations, ischemic digital compression [18,19], soft tissue massage, and/or soft tissue strumming [20] were performed with the primary goal of improving pain free ROM, decreasing capsular restrictions, and resolving taut bands and myofascial trigger points found within the surrounding musculature.

Outcomes

The results presented in **Tables 1-4** demonstrate the success of the treatment in a variety of aspects. In considering the manual muscle testing results, the patient normalized strength tests (5/5 in all tested muscle groups) indicating return of normal strength bilaterally. The ROM measurements showed significant changes in all motions that were initially limited, except for flexion. The lack of gains with flexion will be detailed in the discussion section below. Upon initial examination, the patient presented with a QDASH score of 18. At the time of discharge, the patient had decreased that score to 5, representing a 13-point change, which meets the minimal detectable change of the QDASH [13]. Pain decreased to a subjective pain rating of 0/10 at the end of the treatment sessions. Through completing the implemented treatment plan, the patient tested negative for all clinical special tests and was able to return to her normal activities of daily living. Additionally, the patient was able to return to all rock climbing activities pain free and left for another expedition in Canada following discharge from physical therapy. Finally, this case report demonstrates evidence that a patient with signs and symptoms of the functional classification of SIS is amenable to physical therapy treatment and patients with a functional classification of SIS may benefit and progress to return to all functional activities without surgical intervention. Thus, the success seen in this case report was secondary to the func-

tional classification of SIS seen in this patient as opposed to a structural classification.

Discussion

The treatments performed in this case report were all based on current literature detailing etiology and treatment strategies for SIS. According to Escamilla, Hook, and Wilk, the primary focus of rehabilitation for SIS is to reduce mechanical stress that may be present on the rotator cuff tendon and to restore vascularity to the tendon that may be decreased secondary to a variety of different etiologies [14]. With this rehabilitation focus, goals should be established that focus on the restoration of full glenohumeral joint ROM and rotator cuff dynamic stability [14]. Progressive resistive exercises designed to restore strength and endurance of the rotator cuff and scapular stabilizing muscles while incorporating sport specific training and functional activities should be employed to assist in making a full recovery to functional activities [14]. As the results of this case report demonstrate, the patient successfully met these goals.

On initial evaluation and at discharge, the patient was apprehensive to a bilateral passive stretch of her shoulders in flexion near 150° and did not feel comfortable with further motion. This discomfort represented an empty end feel of motion due to the inability to determine the causative factor of the decreased ROM. It was determined, after discussion with colleagues, the 150° of flexion, bilaterally, represented the patient's normal functional AROM; not the normal 180° as expected. This decreased ROM was most likely secondary to continuous rock-climbing activities which mandated stability of the shoulder girdle complex. Considering this caveat, the patient was able to demonstrate full ROM with all other motions of the glenohumeral joint passively, and also near full AROM in these other motions. Additionally, referring to **Table 4**, it should be noted that a manual muscle test for the upper trapezius was not performed at discharge. This decision was made for two primary reasons. First, literature supports that the upper trapezius is generally found to be hyperactive in SIS and contributes to scapular dyskinesia that is often present [2]. Second, the patient was fully strong without weakness initially and there was no evidence of that changing during the treatment. Hence, a retest was not necessary as a decrease in strength was not seen and/or anticipated.

Current literature supports the use of manual therapy in addition to a supervised therapeutic exercise program in treating functional SIS. This case supports and agrees with current literature. The application of manual therapy in addition to exercise demonstrated significant gains for the patient. Through the use of manual therapy, treatment addressed the restrictions that were present within the glenohumeral joint capsule in the posterior and inferior directions, allowed for soft tissue stretching, and, as hypothesized by Bang and Deyle, stimulated mechanoreceptors to allow a decrease in pain which likely led to an increased ability of the patient to complete therapeutic exercises [11]. The results of this case study add to and support current literature in its successful treatment of functional SIS by conservative measures utilizing manual therapy and supervised therapeutic exercise to prevent re-injury and a return to previously functional status. Future research should focus on the early address of functional SIS with conservative treatments and the use of directed joint mobilizations to enhance the rehabilitation outcomes of postsurgical patients with structural SIS.

Limitations

The primary limitation is that the results of this case report cannot be applied to the general population secondary to the results being from a single patient. While all interventions and treatments were based on current literature, the results achieved in this case report do not apply to all patients who suffer from SIS.

Another limitation was the activity level of the patient during the initial treatment sessions. Although being properly educated on her condition and exacerbating factors, the patient continued to live an active lifestyle which included repetitive overhead activities which may not have allowed the initial inflammation within the subacromial space to resolve.

After extensive patient education, the patient agreed to limit overhead activities to allow the inflammation to resolve and treatment to progress. The patient also was not interested in beginning a regimen of anti-inflammatory medications to assist in symptom resolution which may or may not have contributed to the overall success of the treatment plan.

Conclusion

The purpose of this case report was to describe an episode of care using a conservative approach to the treatment of functional SIS in a professional rock climber. For this patient, four of five established goals were achieved, and the patient was able to leave for another rock climbing expedition at the conclusion of therapy. With current research as the guide for treatment, the patient was able to achieve gains in ROM of the glenohumeral joint, strength of scapular stabilizers and surrounding shoulder musculature, endurance of shoulder musculature, and improve shoulder function as well as a decrease in pain with specific positioning of the involved shoulder. In conclusion, this case report demonstrates that a professional athlete suffering from a functional classification of SIS can experience a full recovery with conservative treatment, avoid the progression to a chronic impairment, and perhaps skirt a surgical intervention decision to resolve the condition.